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U.S. Army Environmental Center

NO FURTHER ACTION DECISION UNDER CERCLA

FORT DEVENS STUDY AREA 28
WASTE EXPLOSIVES DETONATION RANGE
(TRAINING AREA 14)

DATA ITEM A009

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U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MARYLAND

JANUARY 1994

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FORT DEVENS, MASSACHUSETTS

Prepared for:

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TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

NO FURTHER ACTION DECISION UNDER CERCLA
STUDY AREA 28
WASTE EXPLOSIVES DETONATION RANGE
FORT DEVENS, MASSACHUSETTS

LIST OF FIGURES

LIST OF TABLES

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EXECUTIVE SUMMARY

Study Area 28 (one of the 13 Groups 2 and 7 Study Areas) was identified in the Federal Facilities Agreement between the U.S. Environmental Protection Agency and the U.S. Department of Defense as a potential site of contamination. Investigations of Study Area 28 (Waste Explosives Detonation Range [Training Area 14]) at Fort Devens Massachusetts have resulted in the decision that no further hazardous waste studies are required at this site. Any further action should be addressed under applicable Resource Conservation and Recovery Act explosive ordnance disposal closure regulations and standards.

Fort Devens was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act as amended by the Superfund Amendments and Reauthorization Act on December 21, 1989. In addition, under Public Law 101-510, the Defense Base Realignment and Closure Act of 1990, Fort Devens was selected for cessation of operations and closure. In accordance with these acts, numerous studies, including a Master Environmental Plan, an Enhanced Preliminary Assessment, and a Site Investigation have been conducted which address Study Area 28.

Field investigation of Study Area 28 was initiated in 1992 in conjunction with the other twelve Groups 2 and 7 Study Areas at Fort Devens. The Study Area 28 site investigation activities included unexploded ordnance clearing, soil excavation, subsurface soil sampling, monitoring well installation, and groundwater sampling.

Two test pit excavations were dug in each of the two largest impact craters/burn pits identified at Study Area 28. These test pits were excavated by hand to four feet below ground surface and two soil samples were collected from each test pit. The soil samples were analyzed for Project Analyte List organics, inorganics, total petroleum hydrocarbon compounds, and explosives.

Four soil borings were advanced (one upgradient and three downgradient or cross-gradient) in the study area for the purpose of installing groundwater monitoring wells. Two rounds of groundwater samples and water table measurements, three months apart, were collected from the four monitoring wells. The groundwater samples were analyzed for Project Analyte List organics, inorganics, anions/cations, explosives, and total petroleum hydrocarbon compounds.

Sampling and analysis performed on soil and groundwater samples collected during the site investigation indicated that there is no evidence of SA-derived organic compound concentrations exceeding human health guidelines [bis(2-ethylhexyl)phthalate detected in groundwater was determined to be a laboratory contaminant]. Only beryllium in subsurface soil exceeded both background concentrations and human health risk guidelines. However, the detected concentration only slightly exceed the human health risk-based guideline. Aluminum and iron were detected in groundwater at concentrations exceeding background and secondary Maximum Contaminant Level guideline, however, these concentrations are not expected to pose a significant threat to human health. Two inorganic analytes, copper and zinc, detected in surface soils were determined to exceed established ecological benchmark values. Due to the limited ecological habitat present in the vicinity of the impact craters/burn pits where the contaminants were found, these exceedances are not considered to pose significant ecological risk.

On the basis of findings at Study Area 28 and Preliminary Risk Evaluations performed, there is no evidence or reason to conclude that possible hazardous waste contamination due to past site activities has caused significant environmental contamination or poses a threat to human health or the environment. The decision has been made to remove Study Area 28 from further investigation under the Comprehensive Environmental Response, Compensation and Liability Act process and that any further action be addressed under applicable Resource Conservation and Recovery Act closure regulations and standards.

1.0 INTRODUCTION

This decision document has been prepared to support a no further action decision at Study Area 28 (SA 28) - Waste Explosive Detonation Range (Training Area 14) at Fort Devens, Massachusetts. The report was prepared as part of the U.S. Department of Defense (DoD) Base Realignment and Closure (BRAC) program to assess the nature and extent of contamination associated with site operations at Fort Devens.

In conjunction with the Army's Installation Restoration Program (IRP), Fort Devens and the U.S. Army Environmental Center (USAEC; formerly the U.S. Army Toxic and Hazardous Materials Agency) initiated a Master Environmental Plan (MEP) in 1988. The MEP consists of assessments of the environmental status of SAs, specifies necessary investigations, and provides recommendations for response actions with the objective of identifying priorities for environmental restoration at Fort Devens. SA 28 was identified as a potential source of contamination in the MEP. On December 21, 1989, Fort Devens was placed on the National Priorities List under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act.

An Enhanced Preliminary Assessment (PA) was also performed at Fort Devens to address areas not normally included in the CERCLA process, but requiring review prior to closure. A final version of the PA report was completed in April 1992. In 1992, DoD, through U.S. Army Environmental Center (USAEC), also initiated a Site Investigation (SI) for SA 28 along with the other SAs in SA Groups 2 and 7 at Fort Devens. The SI was conducted by ABB Environmental Services, Inc (ABB-ES).

Under Public Law 101-510, the Defense Base Realignment and Closure Act of 1990, Fort Devens has been selected for cessation of operations and closure. An important aspect of BRAC actions is to determine environmental restoration requirements before property transfer can be considered. Studies at SA 28 were conducted to support this overall mission.

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2.0 BACKGROUND AND PHYSICAL SETTING

2.1 DESCRIPTION AND LAND USE

Fort Devens is located approximately 35 miles northwest of Boston, Massachusetts, adjacent to the town of Ayer and within Middlesex and Worcester counties. The installation consists of approximately 9,280 acres and includes portions of the towns of Ayer, Harvard, Lancaster and Shirley. Cities in the vicinity include Fitchburg, Leominster and Lowell. Land surface elevations range from about 200 feet (ft) above mean sea level (MSL) along the Nashua River in the northern portion of the installation to 450 ft above MSL in the southern portion of the installation.

Fort Devens was established in 1917 as Camp Devens, a temporary training camp for soldiers from the New England area. In 1931, the camp became a permanent installation and was redesignated as Fort Devens. Throughout its history, Fort Devens has served as a training and induction center for military personnel and a unit mobilization and demobilization site. All or portions of this function occurred during World Wars I and II, the Korean and Vietnam conflicts, and operations Desert Shield and Desert Storm.

The primary mission of Fort Devens is to command, train, and provide logistical support for non-divisional troop units. The installation also supports that portion of the U.S. Army Intelligence School located at Fort Devens, for the Army Readiness Region, for Reserve Components, and for Army Reserve and National Guard in the New England area.

Fort Devens currently consists of three major land use areas: Main Post, South Post, and North Post (Figure 2-1).

The majority of the facilities on Fort Devens are located in the Main Post area, north of Massachusetts Highway 2. The Nashua River intersects the western edge of the Main Post. The Main Post provides all of the on-post housing, including over 1,700 family units and 9,800 bachelor units (barracks and unaccompanied officer's quarters). Other facilities on the Main Post include community support activities (such as a shoppette, cafeteria, post exchange, commissary, bowling alley, golf course, and hospital), administrative buildings, classrooms and training facilities, maintenance facilities, and ammunition storage facilities.

The North Post is directly north of the Main Post. The principal activities on the North Post are the Douglas E. Moore Army Airfield, and the installation of the waste water treatment plant (WWTP).

The South Post is located south of Massachusetts Highway 2 and contains individual training areas designated for troop training, range activities, and a drop zone. The Nashua River bounds the South Post on the Post's northeast side. The Waste Explosive Detonation Range (Training Area 14) is located on the South Post.

2.2 REGIONAL GEOLOGY

Fort Devens is within the western boundary of the Seaboard Lowland Section of the New England-Maritime physiographic province (Jahns, 1953). Part of the installation lies within the Worcester County Plateau of the Central Uplands province (Koteff, 1966). The land surface is almost completely covered with unconsolidated glacial outwash deposits, resulting in few bedrock outcrops. The surficial deposits are underlain by a highly complex assemblage of intensely folded and faulted metasedimentary rocks with occasional igneous intrusions. The geomorphology of the region is dominated by glacial features such as outwash plains, kames, kame terraces, drumlins, and eskers.

2.3 REGIONAL HYDROGEOLOGY

Groundwater at Fort Devens occurs largely in the permeable glacial-deltaic outwash deposits of sand, gravel, and boulders. Well yields within these sediments are dependent upon the hydraulic characteristics of the aquifer and can range from 2 to over 300 gallons per minute (gpm). Small amounts of groundwater can be obtained from fractured bedrock with yields ranging from 2 to 10 gpm. Minor amounts of groundwater may be found in thin, permeable glacial lenses elsewhere on the installation. The primary hydrogeologic feature at Fort Devens is the Nashua River, which flows through the installation in a south to north direction, with an average discharge rate of 55 cubic feet per second. In addition to the Nashua River, the terrain is dissected by numerous brooks with attendant wetlands. There are also several kettle ponds and one kettle lake located within the installation.

2.4 STUDY AREA DESCRIPTION AND HISTORY

SA 28 is a 6-acre area located on Attu Road in the South Post formerly used as hand grenade range "J" (Figure 2-2). Presently, the southern portion of the area is used as the "medical litter obstacle course." It is bounded on the south by Slate Rock Pond (a manmade pond), on the east and west by woods and on the north by the northern South Post boundary. Attu Road trends east-west through the site. The "medical litter obstacle course" is composed of a bunker constructed of wooden railroad ties (a remnant from the former hand grenade range) and several wooden obstacles. Inferred groundwater flow beneath SA 28 is in a southerly direction toward Slate Rock Pond, at a velocity of 26 feet per year in the northern half of the SA, near the burn pits, and 69 feet per year in the southern half, near Slate Rock Pond. Flow direction estimates are based on water level measurements collected from existing monitoring wells in December 1992.

Hand grenade range "J" was established in the 1940s. No other weapons were reportedly used on this range. It is alleged that waste explosives were disposed of in this area. In the 1970s, the hand grenade range was moved and a portion of the range cleared of unexploded ordnance (UXO) debris and converted to a medical stretcher obstacle training course. Since being converted, several thousand soldiers have used the course and no hazards have been reported (Gates, 1987).

A review of maps at the installation indicate that this range was mapped as a UXO demolition area in 1941 (Construction Division Office of the Construction Quartermaster. 1941). It is believed that the most likely area to have been used for demolition is the clear area located at the northern portion of the site where several topographic depressions (possible impact craters used as burn pits) exist (Figure 2-2).

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3.0 RELATED INVESTIGATIONS

3.1 MASTER ENVIRONMENTAL PLAN

Because initial historical information on SA 28 identified only the use of the hand-grenade range and not the burning and disposal of waste ammunition, the MEP identified SA 28 as an unlikely source of contamination. The MEP did, however, recommend site reconnaissance and soil sampling for explosives analysis to support this position.

3.2 ENHANCED PRELIMINARY ASSESSMENT

The PA included a review of the study and recommendations presented in the MEP and considered other areas that might require evaluation due to the closure of Fort Devens. No additional findings or recommendations for SA 28 were provided in the PA.

3.3 SITE INVESTIGATION REPORT

The SI was initiated in April 1992 and included thirteen of the Groups 2 and 7 SAs listed in the MEP. These SAs are listed below.

- SA 13 (Landfill No. 9)
- SA 45 (Lake George Street Vehicle Wash Area)
- SA 49 (Building 3602 leaking underground storage tank (LUST) Site)
- SA 56 (Building 2417 LUST Site)
- SA 57 (Building 3713 Fuel Oil Spill)
- SA 58 (Buildings 2648 and 2650 Fuel Oil Spill [LUST Site])
- SA 12 (Landfill No. 8)
- SA 14 (Landfill No. 10)
- SA 27 (Waste Explosives Detonation Range)
- **SA 28 (Waste Explosives Detonation Range [Training Area 14])**
- SA 41 (Unauthorized Dumping Area [Site A])
- SA 42 (Popping Furnace)
- SA 43 (Historic Gas Stations)

The SI was conducted by ABB-ES under contract with the USAEC. The Final Site Investigation Report was issued May 1993. The purpose of the SI was to verify the presence or absence of environmental contamination and to determine whether further investigation or remediation was warranted.

The field investigation program at SA 28 consisted of hand excavating test pits for the collection of soil samples in two suspected burn pits, the installation of monitoring wells upgradient and downgradient of the suspected burn pits and the "medical litter obstacle course", and the collection of groundwater samples to assess whether the historic use of the SA has adversely impacted groundwater quality. A UXO clearance survey was conducted to provide access clearance to the burn pits, and downhole clearance in each test pit. During the survey, ammunition shell casings were observed, further supporting the contention that the craters were used as burn pits.

Two test pits (28E-92-01X and 28E-92-02X) were dug to a depth of 4 feet below ground surface (bgs) in the centers of the two largest suspected burn pits (Figure 2-2) to assess whether the historic use of pits had adversely impacted soil quality. Two samples (from 0 to 2 and 2 to 4 feet bgs) were collected from each test pit for laboratory analysis. The four samples were submitted for laboratory analysis of Project Analyte List (PAL) organics and inorganics, Total Petroleum Hydrocarbon Compounds (TPHC), and PAL explosives. In addition to the analytical samples, one sample from each test pit was submitted for grain size analysis.

Four soil borings (28M-92-01X through 28M-92-04X) were drilled to the water table for the installation of groundwater monitoring wells. The regional groundwater flow direction was assumed to be southerly toward Slate Rock Pond; therefore, boring 28M-92-01X was located north of the SA to monitor upgradient groundwater quality. Borings 28M-92-02X through 28M-92-04X were installed crossgradient (east and west) and downgradient (south) of the burn pits and the "medical litter obstacle course," to evaluate whether the historic use of the SA has impacted the downgradient groundwater quality (Figure 2-2). Soil samples were obtained at 5-foot intervals, except in 28M-92-03X where samples were collected continuously, using a 2-inch outside diameter (OD) split spoon sampler. One soil sample was obtained from each of the borings at the water table for laboratory analysis of Total Organic Carbon (TOC).

One monitoring well was installed in each of the soil borings described previously. The monitoring wells were constructed of 4-inch inside diameter (ID) polyvinyl chloride (PVC) and were screened across the water table to monitor for floating contaminants and to allow

for seasonal fluctuations in the water table. Aquifer hydraulic conductivities were evaluated in each newly installed monitoring well by performing two rising-head tests per well.

Two rounds of groundwater samples were collected from each of the newly installed monitoring wells. The first round was collected in September 1992 and the second round was collected in January 1993. A total of four groundwater samples per round were submitted for laboratory analysis of PAL organics and inorganics, TPHC, PAL explosives, and PAL anions and cations. All of the groundwater samples from SA 28, analyzed for inorganics, were collected as non-filtered samples.

3.4 PRELIMINARY RISK EVALUATION

Preliminary Risk Evaluations (PREs) were performed as part of the SI to help establish whether environmental contamination at SA 28 required further investigation or remediation. This section presents the general approach employed for the SI PREs; details of the Human Health and Ecological PREs for SA 28 are presented in Sections 5.0, and 6.0 respectively.

As detailed in Section 3.3, environmental investigations at SA 28 entailed sampling the following environmental media:

- Surface Soil (defined as soil to a depth of 2 feet)
- Subsurface Soil (defined as soil between 2 and 15 feet deep)
- Groundwater

Human Health PREs were conducted to evaluate contamination in surface soil, subsurface soil, and groundwater. An ecological PRE was performed to evaluate contamination in surface soils.

3.4.1 Human Health Risk Evaluation

The Human Health PRE at SA 28 included the following elements:

- **Current and Future Land Use**: Current and foreseeable future land uses are particularly relevant with respect to the applicability of soil screening values used in the PRE. Two sets of soil screening values were used in the evaluation. One set, U.S. Environmental Protection Agency (USEPA) Region III risk-based

concentrations for residential soil, was used when the current and/or foreseeable future land use is residential. The other set, USEPA Region III risk-based concentrations for commercial/industrial soil, was used when the current and/or foreseeable future land use is commercial or industrial.

- **Comparison to Public Health Standards and Guidelines**: For soil and groundwater, human health standards and/or guidelines were used as screening criteria to evaluate the significance of the sampling data. To evaluate the concentrations of compounds detected in groundwater, federal and Massachusetts drinking water standards and guidelines were used. The USEPA's Region III risk-based concentrations were used to evaluate the results of the soil sampling program. The basis and applicability of these standards and guidelines are discussed below.

  USEPA Drinking Water Regulations. Federal drinking water standards (both final and proposed) are used to evaluate the significance of the groundwater sampling data. These standards were extracted at the time of the SI from the USEPA Office of Water's "Drinking Water Regulations and Health Advisories", November 1992.

  Massachusetts Drinking Water Standards and Guidelines. For some compounds, Massachusetts Department of Environmental Protection (MADEP) has promulgated drinking water standards that are more stringent than the federal drinking water standards. MADEP has also developed drinking water guidelines for compounds for which no federal standards exist.

  USEPA Office of Solid Waste and Emergency Response (OSWER) Lead Guidance (OSWER Directive: 9355.4-02). USEPA has set forth an interim soil cleanup level for total lead which is protective for direct contact exposure at residential settings. The interim guidance was published in September 1988. Further guidance will be developed after the USEPA has developed a verified Cancer Potency Factor and/or a Reference Dose for lead.

  USEPA Region III Risk-Based Concentration Table. This table is used by USEPA Region III toxicologists as a risk-based screening tool for Superfund sites, as a benchmark for evaluating preliminary site investigation data and preliminary remediation goals. Although it has no official status either as regulation or guidance, it is useful as a screening tool. The table is updated quarterly and therefore regularly incorporates new USEPA toxicity constants

as they are developed. The First Quarter, 1993 was the current update used in the PRE at the time of the SI.

For the SA 28 Human Health PRE, Region III risk-based concentrations for tap water, commercial/industrial soil, and residential soil were used. Risk-based concentrations for tap water assume daily consumption of two liters of water for a residential lifetime of 30 years; these also assume exposure from the inhalation of volatiles from household water uses (including showering, laundering, and dish washing).

For soil, Region III risk-based concentrations have been developed for commercial/industrial soil exposure as well as for residential exposure. Risk-based concentrations for commercial/industrial soil assume that a worker ingests soil 250 days per year for 25 years, at an ingestion rate of 100 milligrams per day (mg/day). Risk-based concentrations for residential soil assume that an individual ingests soil 350 days per year for a residential lifetime of 30 years, at an age-adjusted ingestion rate of 100 mg/day.

3.4.2 Ecological Risk Evaluations

The ecological PRE at SA 28 included the following elements:

- **Ecological Characterization:** The purpose of the ecological characterization is to identify ecological receptors potentially exposed to contamination at the SA. For part of the research being conducted for the U.S. Army Corps of Engineers, ABB-ES has developed a database for all flora and fauna known to seasonally or permanently occur at, or migrate through, Fort Devens (ABB-ES, November 1992). Particular emphasis has been paid to rare and endangered biota; the term "rare and endangered" is used to refer to those species with protected status under the Federal Endangered Species Act (FESA) of 1973, as amended in 1988, and the Massachusetts Endangered Species Act (MESA) of 1990. The most current versions of both state and federal rare and endangered species lists have been included in this Fort Devens Biological Database. Information regarding all rare and endangered species known to occur at Fort Devens has been obtained from the Massachusetts Natural Heritage Program (MNHP) and the U.S. Fish and Wildlife Service (USFWS). In addition, the ABB-ES database contains records that have not yet been incorporated into the MNHP database. This database was used to ascertain whether or not SA 28 is providing rare and endangered species habitat.

- **Comparison to Ecological Standards and Criteria**: This element of the ecological PRE identifies possible ecological exposure pathways, and serves to characterize the risk to terrestrial and aquatic receptors potentially exposed to environmental contamination at the SA. Exposure pathways describe the mechanism(s) by which ecological receptors are exposed to contaminated media, and consist of a: (1) contaminant source; (2) environmental transport medium; (3) point of receptor contact; and (4) the exposure route (e.g., ingestion of prey items that have bioaccumulated contaminants in their tissues, drinking of contaminated surface water, incidental sediment ingestion, dermal absorption, inhalation, etc.). Potential receptors at SA 28 include:

    - Terrestrial biota in uplands

No state or federal standards or guidelines exist for surface soil exposure, so it has been evaluated through comparison of maximum analyte concentrations in surface soils to protective contaminant levels (PCLs) obtained through a computer-generated chronic exposure food web model. In order to establish conservative PCLs for the screening level PRE, an acceptable level of risk (Hazard Index [HI] equals 1) associated with chronic exposure to each surface soil contaminant isolated at SA 28 was established. The food model is further described in the SI (ABB-ES, 1993).

The surface soil PCLs have been collectively referred to as benchmark values. When more than one benchmark value is available per analyte per medium, professional judgment was used to select the appropriate value for use in the PRE.

Screening of ecological risk at SA 28 was based on establishing a contaminant-specific ratio between the average exposure concentrations and the benchmark values. This comparison of the exposure concentration with the appropriate benchmark results in an index of potential impact associated with exposure to environmental contaminants. When the average exposure concentration is less than the benchmark value (i.e., the ratio of the exposure concentration to the benchmark value < 1), ecological risk was assumed to be insignificant. When the value exceeds the exposure concentration (i.e., the ratio of the exposure concentration to the benchmark value > 1), a discussion of the ecological significance of this exceedance was included in the PRE. This conservative approach provides a screening-level evaluation of potential effects of individual Chemicals of Potential Concern (CPCs) on ecological receptors.

4.0 CONTAMINATION ASSESSMENT

The SA 28 SI analytical results are discussed by medium in the following subsections. Laboratory analytical results are included in Appendix K of the SI Report (ABB-ES, 1993).

The objective of the sampling program at SA 28 was to investigate the potential presence of environmental contamination generated by the historical use of the explosives detonation range and demolition range and, if found, assess the vertical and horizontal distribution of contaminants, and to recommend further actions. Soil borings were advanced up and down gradient of the SA for the purposes of installing groundwater monitoring wells for the collection of groundwater samples. Shallow test pit excavations were dug for the purpose of collecting soil samples in two suspected burn pits. The burn pits were selected for sampling because of visible evidence of ammunition debris based on the UXO survey conducted prior to the investigation. Soil samples from these suspected burn pits were submitted for laboratory analysis of PAL organics, PAL inorganics, TPHC, and PAL explosives. Groundwater samples were submitted for laboratory analysis of PAL organics and inorganics, TPHC, and PAL explosives.

4.1 SOILS

Two soil samples each were collected from two test pits hand excavated in the suspected burn pits. One soil sample from each test pit was collected from the surface, and another from the depth interval 2 feet to 4 feet bgs. No volatile organic compounds (VOCs) were detected in any of the samples and bis(2-ethylhexyl)phthalate (B2EHP) and n-nitrosodiphenylamine were the only semivolatile organic compounds (SVOCs) detected. B2EHP is considered a common laboratory contaminant and does not appear to be a site contaminant. N-nitrosodiphenylamine is a suspected degradation product of explosives. All four samples contained detectable concentrations of TPHC; the highest concentration (159 micrograms per gram (μg/g)) was detected in the surface sample collected from 28E-92-02X. 4,4'-Dichlorodiphenyl trichloroethane (4,4'-DDT), 4,4'-dichlorodiphenyl dichloroethane (4,4'-DDD), and 4,4'-dichlorodiphenyl dichloroethene (4,4'-DDE) were also detected in 28E-92-01X at 2 feet to 4 feet and in 28E-92-02X at 0 feet to 2 feet bgs (Table 4-1; Figure 4-1).

Inorganic analytes (beryllium, copper, iron, lead, sodium, and zinc) were detected at concentrations above the established Fort Devens background concentrations (ABB-ES, 1993) in the 2-foot to 4-foot sample from 28E-92-01X and the 0-foot to 2-foot sample from 28E-92-02X samples. The remaining two samples contained elevated sodium only (Table 4-2; Figure 4-2).

4.2 GROUNDWATER

No organic compounds other than B2EHP were detected in groundwater samples collected from the four monitoring wells at SA 28. B2EHP is considered a common laboratory contaminant and does not appear to be a site contaminant. Inorganic analytes were detected at concentrations above their established Fort Devens background concentration in three of the four groundwater samples (28M-92-02X through 28M-92-04X) collected during Round 1. Total Suspended Solids (TSS) analysis was not conducted on the samples collected during Round 1. The results for the Round 2 groundwater samples did not indicate the presence of any organic compounds. Inorganic analytes were detected above the established Fort Devens background concentrations but the total number of inorganic analytes detected was less in Round 2. Round 2 analytes included barium and potassium in 28M-92-02X and zinc in 28M-92-01X through 28M-92-04X. As part of the Round 2 groundwater sampling event, each groundwater sample was analyzed for TSS to evaluate the inorganic concentrations detected in the groundwater samples. The results of this analysis indicated that TSS was present in the groundwater samples collected from SA 28 ranging from 55 milligrams per liter (mg/L) in 28M-92-01X to 108 mg/L in 28M-92-02X. Based on these results, it appears that the inorganics detected above their established background are a function of suspended solids rather than dissolved constituents (Table 4-3; Figure 4-3).

4.3 QUALITY CONTROL BLANKS

The Quality Control Blanks analyzed during the Groups 2 and 7 SI included method blanks, trip blanks, and rinsate blanks. Method blanks were analyzed to determine if compound analytes were introduced at the laboratory. The purpose of trip and rinsate blanks was to determine if cross contamination of samples occurred from shipment and storage and if decontamination procedures impacted analyte concentrations, respectively. Data were generated by Environmental Science and Engineering, Inc. (ESE) laboratories from soil and water samples collected from July through October 1992. Two field blanks of the USAEC

approved source water were collected and analyzed prior to the start of the Groups 2 and 7 SI.

The following data is a presentation of B2EHP detects above Certified Reporting Limit (CRL) values in the SA Groups 2 and 7 method, rinsate, and field blanks and the frequency at which they were found.

B2EHP was found in only one method blank at a reported concentration of 0.97 μg/g. Phthalate esters are identified as common laboratory contaminants by the EPA[1].

B2EHP was the only Base Neutral/Acid Extractable organic (BNA) compound above the CRL detected in the field blanks. The concentrations at which it was found was 9.9 μg/L and 53 μg/L for an average value of 32 μg/L. B2EHP was likely introduced as a laboratory contaminant during sample preparation.

B2EHP was not detected above the CRL in any of the four rinsate blanks collected during the Groups 2 and 7 SI.

For further information on Quality Control Blanks refer to Appendix E of the Groups 2 and 7 Final SI Report (ABB-ES, 1993).

[1] CLP Program Statement of Work, March 1990.

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5.0 PRELIMINARY HUMAN HEALTH RISK EVALUATION

Tables 5-1 through 5-3 present the statistics and human health standards and guidelines used in the human health Preliminary Risk Evaluation (PRE) for SA 28 summarized below.

5.1 SOILS

Typically, the preliminary risk evaluation methodology considers all soils to a depth of 3 feet as accessible under a residential future use exposure scenario. All soils collected from 3-15 feet in depth are considered to be accessible under a commercial/industrial future use exposure scenario. However, in the case of SA 28, soil samples were taken from two depths (0 to 2 feet and greater than 2 feet). For the purpose of this PRE, the samples taken at SA 28 from 0 to 2 feet will be considered surface soils and the samples taken from 2 feet and greater will be considered subsurface soils.

5.1.1 Surface Soils

Table 5-1 presents summary statistics on surface soil at SA 28 and USEPA Region III residential soil risk-based concentrations for comparison (ABB-ES, 1993). Surface soil at SA 28 is represented by samples 28E-92-01X and 28E-92-02X. An assessment of the organic compound data for SA 28 surface soils shows that there is limited contamination from 4,4'-DDE, 4,4'-DDT, and B2EHP. The maximum detected concentrations of the organic compounds are, however, below the USEPA Region III residential soil concentrations. TPHC was included in the PRE, however, no Region III benchmark values were available.

When comparing against statistical background, the inorganic data for SA 28 surface soils show that there are several compound exceedances, most notably copper, sodium, and zinc. Of the three analytes detected above the established background concentrations, none of the analytes were detected at concentrations above their respective health-based soil guidelines. One additional analyte, arsenic, was detected at concentrations above the USEPA Region III residential soil concentrations. Although arsenic was detected at concentrations above the residential soil concentration (0.97 μg/g), the maximum detected concentration did not exceed the established Fort Devens background concentration for arsenic (21 μg/g).

5.1.2 Subsurface Soils

Table 5-2 presents summary statistics on subsurface soil at SA 28 and USEPA Region III commercial/industrial soil concentrations for comparison. Subsurface soil at SA 28 is represented by samples 28E-92-01X and 28E-92-02X. An assessment of the organic compound data for SA 28 subsurface soils shows that there is limited contamination from 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and n-nitrosodiphenylamine. The maximum detected concentrations of the organic compounds are, however, below the USEPA Region III commercial/industrial soil concentrations.

When comparing against the established Fort Devens soil background, the inorganic data for SA 28 subsurface soils show that there are several compound exceedances, most notably beryllium, copper, iron, lead, sodium, and zinc. Of the six analytes detected above the established background levels, only beryllium was detected at a concentration (0.74 μg/g) marginally above its respective health-based soil guideline (0.67 μg/g). Beryllium was detected in one of the two subsurface soil samples analyzed for inorganic analytes. One additional analyte, arsenic, was detected at concentrations above the USEPA Region III commercial/industrial soil concentrations. Although arsenic was detected at concentrations above the commercial/industrial soil concentration (1.6 μg/g), the maximum detected concentration (10.8 μg/g) did not exceed the base-wide background concentration for arsenic (21 μg/g).

5.2 GROUNDWATER

Table 5-3 presents summary statistics on groundwater associated with SA 28 and drinking water standards/guidelines for comparison. Monitoring wells 28M-92-01X through 28M-92-04X represent the groundwater associated with SA 28.

Two organic compounds were detected in the groundwater associated with SA 28: B2EHP and chloroform. The maximum detected concentration of chloroform was below its drinking water standard/guideline. B2EHP was detected in two of nine samples and the maximum and average concentrations exceeded the USEPA Region III tap water concentration; however, B2EHP is a common laboratory contaminant and is not considered to be an SA-related contaminant.

An assessment of the inorganic data for SA 28 groundwater shows that there is inorganic analyte contamination directly surrounding the SA. When comparing groundwater

concentrations to the statistical background, the inorganic data for SA 28 groundwater shows that there are several compound exceedances, most notably, aluminum and iron.

A drinking water standard or guideline (USEPA, 1992) is available for nine of the ten inorganic analytes detected above the established background concentrations. Of the nine inorganic analytes detected above the established background levels, two analytes were detected at concentrations above their respective drinking water standard/guideline. Aluminum and iron were detected in nine of nine samples collected and each average concentration exceeded its respective USEPA secondary Maximum Contaminant Level (MCL). Secondary MCLs are set for aesthetic or economic reasons, not health reasons. The average concentration of manganese in groundwater also exceeded the secondary MCL; however, the maximum detected concentration is below the established background. Based on this screening-level analysis, contaminants detected in groundwater at SA 28 are not expected to pose a significant risk to public health.

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6.0 PRELIMINARY ECOLOGICAL RISK EVALUATION

The purpose of the ecological PRE for SA 28 is to provide a screening-level evaluation of actual and potential risks that environmental contaminants may pose to the resident and migratory ecological receptors at the site.

The obstacle course facility is an unpaved sand lot with little vegetation. Herbaceous species (predominantly graminoids) cover approximately 10 percent of the area; occasional sweet fern (*Comptonia peregrina*) also occurs at the obstacle course. This area provides minimal habitat for wildlife species.

The suspected burn pits occur in a mixed white pine (*Pinus strobus*) and oak (*Quercus spp.*) forest, with a moderately dense understory. Plant species observed in this region include gray birch (*Betula populifolia*), sweet fern (*Comptonia peregrina*), bracken fern (*Pteridium aquilinum*), and lowbush blueberry (*Vaccinium angustifolium*). The pits are small in size, and likely do not provide significant wildlife habitat. In addition, the sandy soils in the region do not permit water to remain on the surface for sufficient time to provide aquatic or vernal pool habitat (Poole, 1993).

No records exist documenting the current or historical presence of rare and endangered fauna in the region of SA 28. However, a state-listed plant species is known to occur at or in the vicinity of the site (Hunt and Zaremba, 1992).

Three organic analytes (4,4'-DDT, 4,4'-DDE, and B2EHP) were detected in two surface soil samples collected from the impact craters; all three were chosen as CPCs. Eleven inorganic analytes were also detected in these two samples (Table 6-1). The maximum concentrations of copper and zinc were higher than the installation-wide background concentrations and these analytes were therefore chosen as surface soil CPCs. Copper occurred at both test pit locations at a maximum concentration of 306 μg/g. Zinc was detected in both samples at a maximum concentration of 8,300 μg/g.

Although the SA 28 pits provide minimal wildlife habitat, potential contaminant exposure pathways may exist for terrestrial receptors via incidental soil ingestion and terrestrial food web exposure.

A screening-level evaluation of potential effects from impact craters surface soil exposure was conducted by comparing the maximum concentrations of 4,4'-DDT, 4,4'-DDE, B2EHP,

copper, and zinc to their respective surface soil benchmark values (see Table 6-1). The maximum concentrations of 4,4'-DDT, 4,4'-DDE, and B2EHP were less than their benchmark values. TPHC was not evaluated in the PRE, however, SVOCs (the major components of the TPHC analysis) were evaluated and no risk to ecological receptors was determined. The maximum concentrations of copper and zinc, however, were greater than their established surface soil benchmark values. Copper was detected at concentrations ranging from 4 to 306 μg/g, with an average concentration of 155 μg/g. This average concentration is approximately 5 times the ecological benchmark for copper. Zinc was detected at a maximum concentration of 8,300 μg/g, with an average concentration of 4,157 μg/g, approximately 6.5 times its benchmark value.

Because of the limited habitat associated with the suspected burn pits, it is unlikely that significant ecological risk results from the concentrations of zinc and copper in surface soil at SA 28.

7.0 CONCLUSIONS

No further action is recommended for SA 28. This recommendation is based on historical site use as confirmed by physical observations, sampling, and chemical analysis, and based on the results of human health and ecological PREs.

The primary concern at SA 28 has been the residual contamination due to releases from historical waste explosives detonation. Sampling and analysis during the SI, however, revealed no significant soil or groundwater contaminant levels. PREs conducted for detected contaminants also indicated that no unacceptable ecological and human health risks are associated with this study area. Therefore, no further investigation activities are recommended for SA 28.

The Army has proposed that SA 28 be considered for Resource Conservation and Recovery Act (RCRA) closure of the thermal oxidizing units (burn pits) as part of Group 1B remedial activities.

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8.0 DECISION

On the basis of findings at SA 28, there is no evidence or reason to conclude that possible hazardous waste contamination due to contents in the ~~landfill~~ former waste collection & detention has caused significant environmental contamination or poses a threat to human health or the environment. The decision has been made to remove SA 28 from further consideration in the IRP process and that any further action be addressed under applicable RCRA regulations and standards.

Lange JPB 7/6/94 2

COMMANDER, FORT DEVENS

COLONEL EDWARD NUTTALL
U.S. Army
Installation Commander

12 JAN 94
Date

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION I, ME AND VT WASTE MANAGEMENT BRANCH

[✓] Concur

David M. Webster
Signature
David M. Webster, Chief

LG 7/22/94

8/2/94
Date

[ ] Non-concur (Please provide reasons) _____

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ABB-ES	ABB Environmental Services, Inc.
B2EHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BNA	Base Neutral/Acid Extractable organic
BRAC	Defense Base Realignment and Closure Act of 1990
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPC	Chemicals of Potential Concern
CRL	Certified Reporting Limit
4,4'-DDD	4,4'-dichlorodiphenyl dichloroethane
4,4'-DDE	4,4'-dichlorodiphenyl dichloroethene
4,4'-DDT	4,4'-dichlorodiphenyl trichloroethane
DoD	U.S. Department of Defense
ESE	Environmental Science and Engineering, Inc.
FESA	Federal Endangered Species Act
ft	foot or feet
gpm	gallons per minute
ID	inner diameter
IRP	Installation Restoration Program
LUST	leaking underground storage tank
MADEP	Massachusetts Department of Environmental Protection
MCL	Maximum Contaminant Level
MEP	Master Environmental Plan
MESA	Massachusetts Endangered Species Act
mg/day	milligrams per day
mg/L	milligrams per liter
MNHP	Massachusetts Natural Heritage Program
MSL	mean sea level

OD	outside diameter
OSWER	USEPA Office of Solid Waste and Emergency Response
PA	Enhanced Preliminary Assessment
PAL	Project Analyte List
PCL	protective contaminant level
PRE	Preliminary Risk Evaluation
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
SA	Study Area
SI	Site Investigation
SVOC	semivolatile organic compound
TOC	total organic carbon
TPHC	total petroleum hydrocarbon compounds
TSS	total suspended solids
µg/g	micrograms per gram
µg/l	micrograms per liter
USAEC	U.S. Army Environmental Center
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
UXO	unexploded ordnance
VOC	volatile organic compound
WWTP	wastewater treatment plant

ABB Environmental Services, Inc. (ABB-ES), 1993. "Final Site Investigation Report - Groups 2 & 7 and Historic Gas Stations, Fort Devens, Massachusetts"; Data Item A009; prepared for the U.S. Army Environmental Center by ABB Environmental Services, Inc., Portland, ME; May.

ABB Environmental Services, Inc. (ABB-ES), 1992. "Biological and Endangered Species Baseline Study, Fort Devens, Massachusetts-Preliminary Draft"; November.

Biang, C.A., R.W. Peters, R.H. Pearl, and S.Y. Tsai, 1992. "Master Environmental Plan for Fort Devens, Massachusetts"; prepared for U.S. Army Toxic and Hazardous Materials Agency; prepared by Argonne National Laboratory, Environmental Assessment and Information Sciences Division; Argonne, IL; Final, April.

Gates, W.C.B., 1987. "Hydrogeologic Assessment Plan No. 38-26-0653-87, Fort Devens, Massachusetts"; U.S. Army Forces Command, Fort Gillem, Forest Park, Georgia; February 10.

Hunt, D. and R. Zaremba, 1992. "Floristic Survey with Emphasis on Rare Species, of Fort Devens, Massachusetts"; Massachusetts Division of Fish and Wildlife; Boston, MA.

Jahns, R.H., 1953. "Surficial Geology of the Ayer Quadrangle, Massachusetts"; Scale 1:31,680; U.S. Geological Survey.

Koteff, C., 1966. "Surficial Geologic Map of the Clinton Quadrangle, Worcester County, Massachusetts;" U.S. Geological Survey Map GQ-567.

Poole, T., 1993. Personal communication from Forester, DEH Technical Services Branch, to ABB Environmental Services, Inc., Fort Devens.

U.S. Army, 1941. "Site Plan"; Construction Division - Office of the Construction Quartermaster.

U.S. Environmental Protection Agency (USEPA), 1992. "Drinking Water Regulations and Health Advisories"; Office of Drinking Water, Washington, DC.

U.S. Environmental Protection Agency (USEPA), 1993. Region III Risk-Based Concentration Tables, First Quarter.

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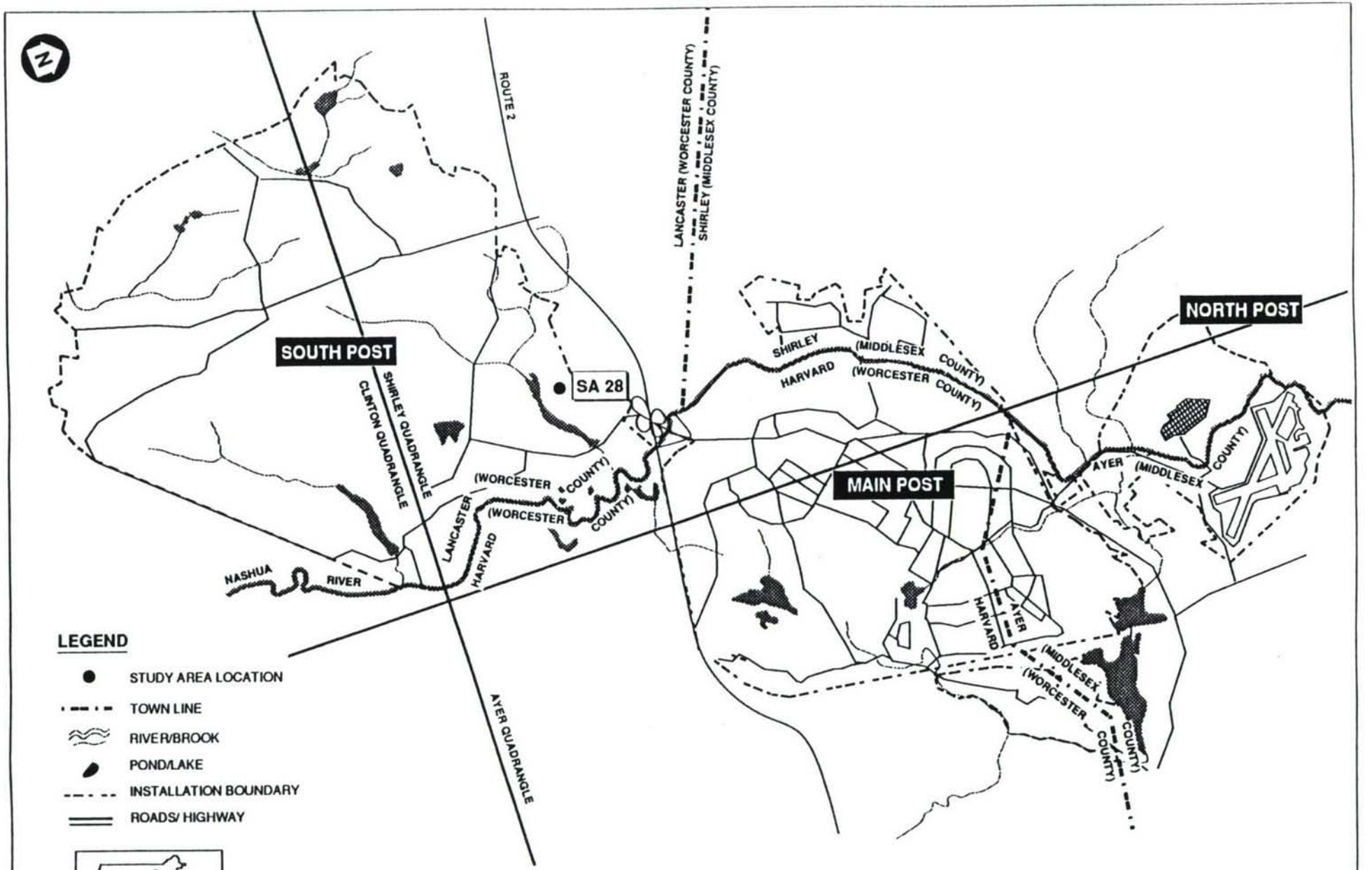

FIGURE 2-1
LOCATION OF FORT DEVENS
STUDY AREA 28 DECISION DOCUMENT
FORT DEVENS, MA

ABB Environmental Services, Inc.

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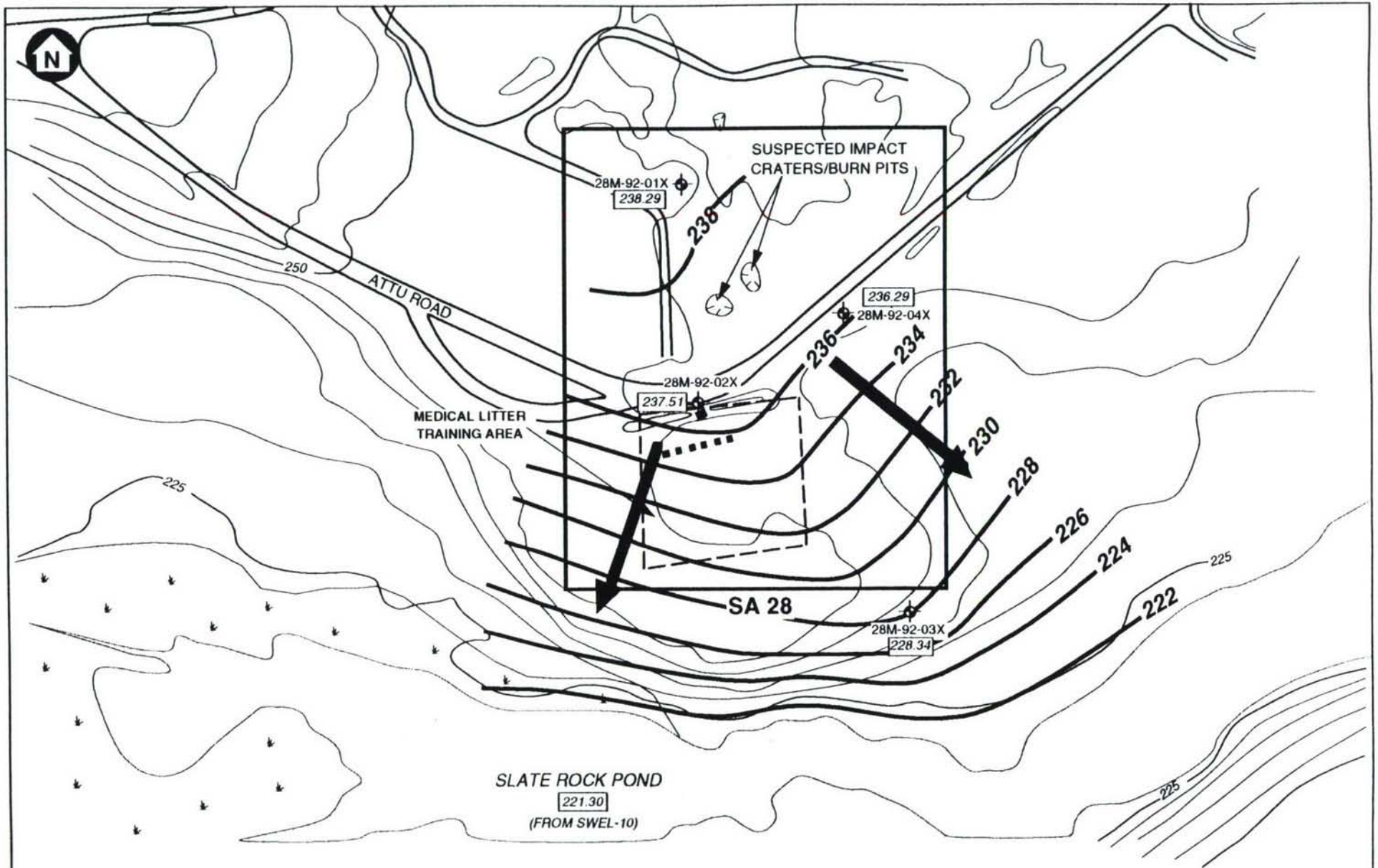

FIGURE 2-2
GROUNDWATER LEVELS AND INFERRED FLOW DIRECTION
STUDY AREA 28 DECISION DOCUMENT
FORT DEVENS, MA

ABB Environmental Services, Inc.

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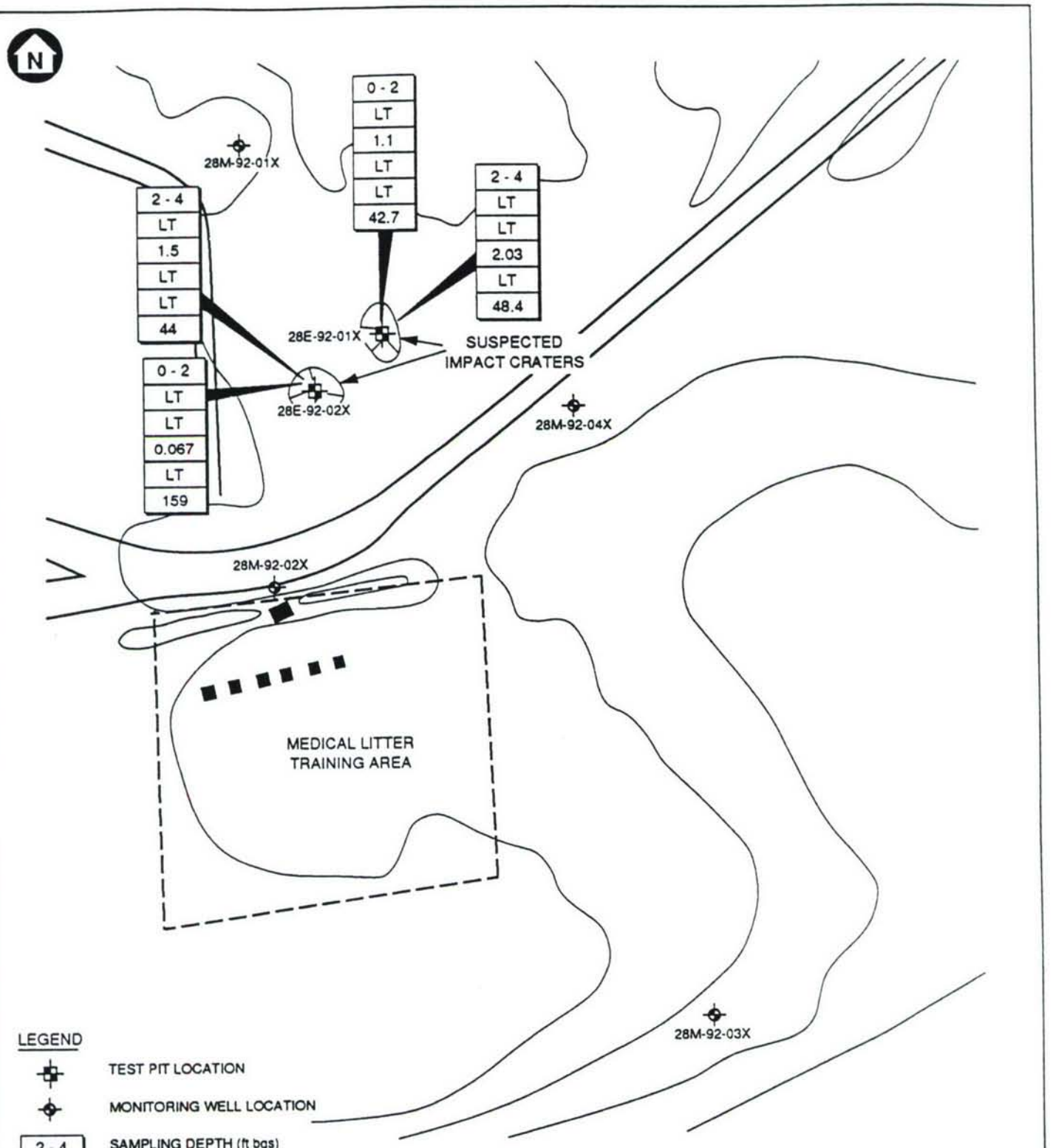

FIGURE 4-1
ORGANIC COMPOUNDS IN SOIL
STUDY AREA 28 DECISION DOCUMENT
FORT DEVENS, MA

ABB Environmental Services, Inc.

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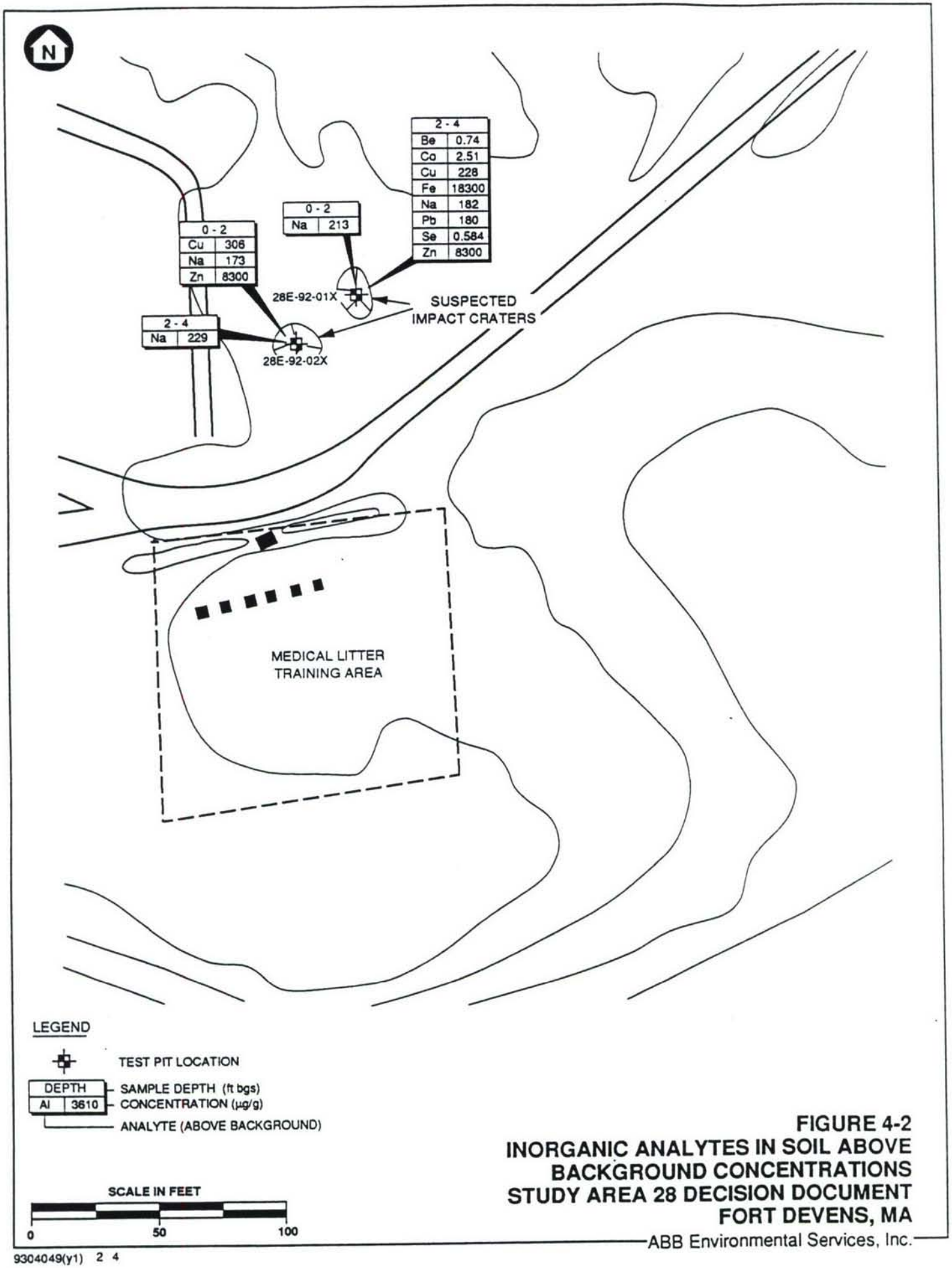

FIGURE 4-2
INORGANIC ANALYTES IN SOIL ABOVE BACKGROUND CONCENTRATIONS
STUDY AREA 28 DECISION DOCUMENT
FORT DEVENS, MA

ABB Environmental Services, Inc.

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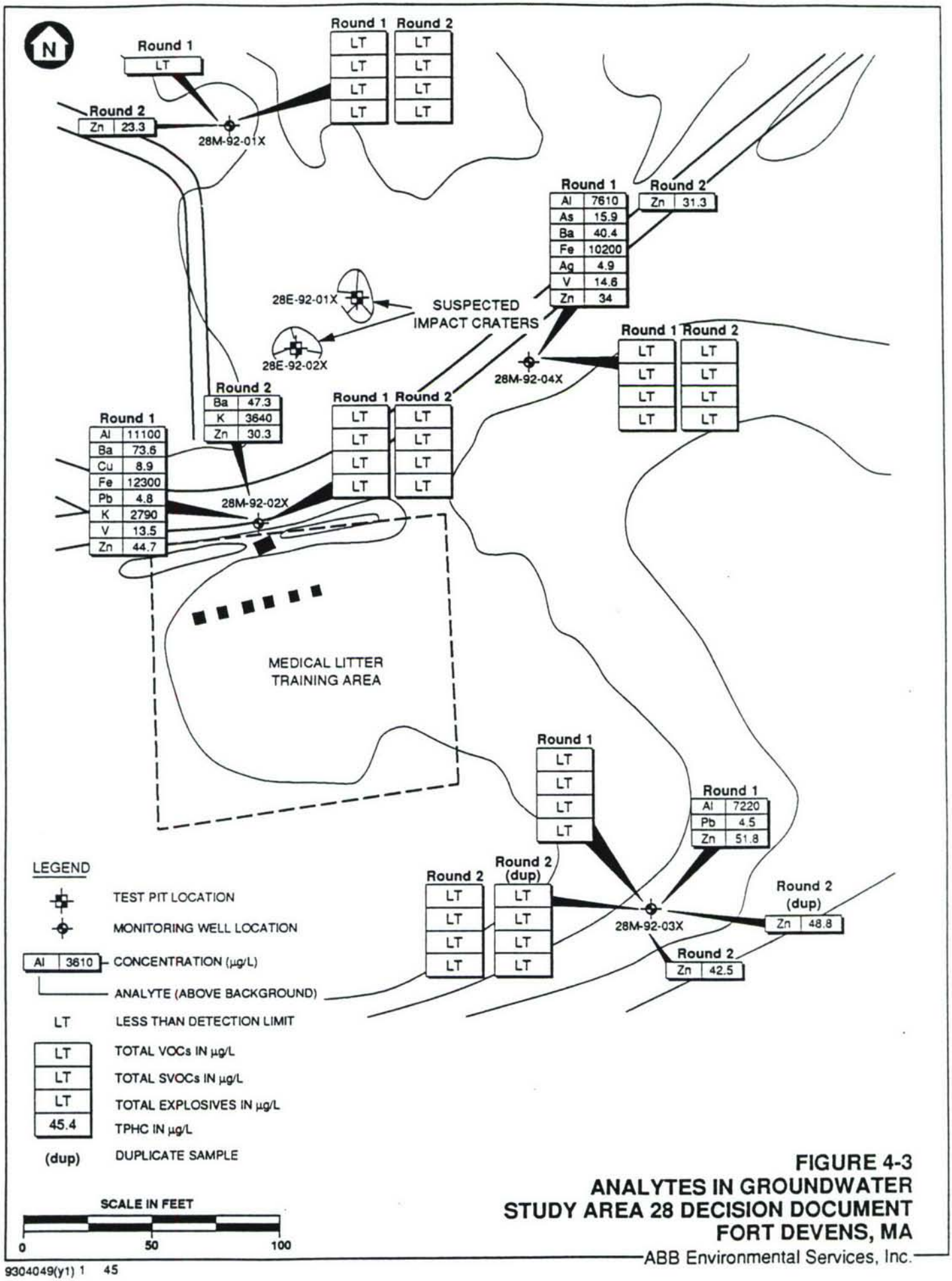

FIGURE 4-3
ANALYTES IN GROUNDWATER
STUDY AREA 28 DECISION DOCUMENT
FORT DEVENS, MA

ABB Environmental Services, Inc.

TABLE 4-1
ORGANIC COMPOUNDS IN SOIL
STUDY AREA 28 – WASTE EXPLOSIVE DETONATION RANGE (TRAINING AREA 14)

DECISION DOCUMENT
FORT DEVENS

ANALYTE	TEST PIT	28E-92-01X	28E-92-01X	28E-92-02X	28E-92-02X
	DEPTH	0 FT	2 FT	0 FT	2 FT
SEMIVOLATILES (ug/g)					
BIS(2-ETHYLHEXYL)PHTHALATE		1.1	< 0.6	< 0.6	< 0.6
N-NITROSODIPHENYLAMINE		< 0.2	< 0.2	< 0.2	1.5
PESTICIDES/PCBS (ug/g)					
4,4'-DDD		< 0.008	0.045	< 0.008	< 0.008
4,4'-DDE		< 0.008	0.38	0.016	< 0.008
4,4'-DDT		< 0.007	1.6	0.051	< 0.007
OTHER (ug/g)					
TOTAL PETROLEUM HYDROCARBON		42.7	48.4	159.0	44.0

NOTES:

TABLE LISTS DETECTED ANALYTES ONLY – SEE PROJECT ANALYTE LIST FOR SUMMARY

< = LESS THAN DETECTION LIMIT SHOWN

NA = NOT ANALYZED

TABLE 4-2
INORGANIC ANALYTES IN SOIL
STUDY AREA 28 – WASTE EXPLOSIVE DETONATION RANGE (TRAINING AREA 14)

DECISION DOCUMENT
FORT DEVENS

ANALYTE (ug/g)	BACK-GROUND	TEST PIT DEPTH	28E-92-01X 0 FT	28E-92-01X 2 FT	28E-92-02X 0 FT	28E-92-02X 2 FT
ALUMINUM	15000.0		3400.0	5340.0	4250.0	4550.0
ANTIMONY	NA		< 1.1	3.23	< 1.1	< 1.1
ARSENIC	21.0		3.31	8.05	8.05	10.8
BARIUM	42.5		17.5	27.0	20.6	25.6
BERYLLIUM	.347		< 0.5	0.74	< 0.5	< 0.5
CALCIUM	1400.0		747.0	260.0	277.0	642.0
CHROMIUM	31.0		<4.0	7.65	6.01	<4.0
COBALT	NA		< 1.4	2.51	< 1.4	< 1.4
COPPER	8.39		3.95	228.0	306.0	4.98
IRON	15000.0		4020.0	18300.0	6540.0	4340.0
LEAD	48.4		3.08	180.0	29.0	5.25
MAGNESIUM	5600.0		868.0	920.0	1010.0	972.0
MANGANESE	300.0		40.7	199.0	67.9	44.4
MERCURY	0.22		< 0.05	< 0.05	0.105	< 0.05
NICKEL	14.0		3.81	8.17	5.82	4.23
POTASSIUM	1700.0		588.0	393.0	495.0	693.0
SELENIUM	NA		< 0.25	0.584	< 0.25	< 0.25
SODIUM	131.0		213.0	182.0	173.0	229.0
VANADIUM	28.7		5.29	6.27	5.38	6.7
ZINC	35.5		13.6	8300.0	8300.0	16.3

NOTES:

TABLES LISTS DETECTED ANALYTES ONLY – SEE PROJECT ANALYTE LIST FOR SUMMARY

< = LESS THAN DETECTION LIMIT SHOWN

NA = NOT AVAILABLE

[ ] = VALUE ABOVE BACKGROUND LEVEL

TABLE 4-3
ANALYTES IN GROUNDWATER
STUDY AREA 28 – WASTE EXPLOSIVE DETONATION RANGE (TRAINING AREA 14)

DECISION DOCUMENT
FORT DEVENS

ANALYTE	BACK-GROUND	ROUND 1 28M-92-01X	ROUND 2 28M-92-01X	ROUND 1 28M-92-02X	ROUND 2 28M-92-02X
INORGANICS (µg/L)					
ALUMINUM	6870.0	2280.0	1860.0	11100.0	2340.0
ARSENIC	10.5	3.9	< 2.54	9.5	< 2.54
BARIUM	39.6	14.4	15.3	73.6	47.3
CALCIUM	14700.0	1910.0	1490.0	7530.0	7070.0
CHROMIUM	14.7	< 6.0	< 6.0	14.1	< 6.0
COPPER	8.09	< 8.0	< 8.0	8.9	< 8.0
IRON	9100.0	2410.0	1810.0	12300.0	2670.0
LEAD	4.25	2.2	1.52	4.8	2.17
MAGNESIUM	3480.0	693.0	545.0	3010.0	1120.0
MANGANESE	291.0	86.4	43.1	252.0	46.0
POTASSIUM	2370.0	461.0	1560.0	2790.0	3640.0
SILVER	4.6	< 4.6	< 4.6	< 4.6	< 4.6
SODIUM	10800.0	1380.0	1430.0	7760.0	8600.0
VANADIUM	11.0	< 11.0	< 11.0	13.5	< 11.0
ZINC	21.1	< 21.1	23.3	44.7	30.3
ANIONS/CATIONS (µg/L)					
NITRATE/NITRITE		26.9	11.1	1900.0	880.0
CHLORIDE		< 2120.0	< 2120.0	16000.0	11300.0
ALKALINITY		7000.0	5000.0	14000.0	12000.0
BICARBONATE		8540.0	6100.0	17100.0	14600.0
OTHER (mg/L)					
TOTAL SUSPENDED SOLIDS		NA	55.0	NA	108.0

NOTES:

TABLE LISTS DETECTED ANALYTES ONLY – SEE PROJECT LIST FOR SUMMARY

< = LESS THAN DETECTION LIMIT SHOWN

[ ] = VALUE ABOVE BACKGROUND LEVELS

NA = NOT ANALYZED

TABLE 4–3 (continued)
ANALYTES IN GROUNDWATER
STUDY AREA 28 – WASTE EXPLOSIVE DETONATION RANGE (TRAINING AREA 14)

DECISION DOCUMENT
FORT DEVENS

ANALYTE	BACK-GROUND	ROUND 1 28M-92-03X	ROUND 2 28M-92-03X	ROUND 2 28M-92-03X DUP	ROUND 1 28M-92-04X	ROUND 2 28M-92-04X
INORGANICS (µg/L)						
ALUMINUM	6870.0	7220.0	2740.0	2810.0	7610.0	1880.0
ARSENIC	10.5	9.4	2.88	< 2.54	15.9	3.09
BARIUM	39.6	31.9	15.2	16.0	40.4	37.3
CALCIUM	14700.0	3890.0	3180.0	3070.0	3120.0	3730.0
CHROMIUM	14.7	9.3	< 6.0	< 6.0	9.3	< 6.0
COPPER	8.09	< 8.0	< 8.0	< 8.0	< 8.0	< 8.0
IRON	9100.0	6860.0	2320.0	2530.0	10200.0	2550.0
LEAD	4.25	4.5	1.95	2.17	2.6	1.41
MAGNESIUM	3480.0	1560.0	699.0	741.0	1950.0	1060.0
MANGANESE	291.0	223.0	108.0	110.0	184.0	49.7
POTASSIUM	2370.0	1610.0	1590.0	1680.0	2120.0	982.0
SILVER	4.6	< 4.6	< 4.6	< 4.6	4.9	< 4.6
SODIUM	10800.0	1610.0	1580	1520.0	3820.0	4430.0
VANADIUM	11.0	< 11.0	< 11.0	< 11.0	14.6	< 11.0
ZINC	21.1	51.8	42.5	48.8	34.0	31.3
ANIONS/CATIONS (µg/L)						
NITRATE/NITRITE		24.9	15.4	14.3	11.8	18.6
CHLORIDE		< 2120.0	< 2120.0	< 2120	4580.0	4710.0
ALKALINITY		9000.0	18000.0	11000.0	15000.0	< 5000.0
BICARBONATE		11000.0	22000.0	13400.0	18300.0	< 6100.0
OTHER (mg/L)						
TOTAL SUSPENDED SOLIDS		NA	93.0	86.0	NA	84.0

NOTES:
TABLE LISTS DETECTED ANALYTES ONLY – SEE PROJECT LIST FOR SUMMARY
< = LESS THAN DETECTION LIMIT SHOWN
[ ] = VALUE ABOVE BACKGROUND LEVELS
NA = NOT ANALYZED

Table 5-1
Human Health PRE Evaluation of Surface Soil
Study Area 28 – Waste Explosives Denotation Range (Training Area 14)

Decision Document
Fort Devens

Analyte	Soil Background Concentration [a] (ug/g)	Detected Concentration [b] Average (ug/g)	Detected Concentration [b] Maximum (ug/g)	Frequency of Detection	Maximum Exceeds Background ?	Region III Residential Soil Concentration (ug/g)	Maximum Exceeds Region III Concentration ?
Organics							
4,4'-DDT		0.051	0.051	1/2		5	NO
4,4'-DDE		0.016	0.016	1/2		5	NO
bis (2-ethylhexyl) phthalate		1.1	1.1	1/2		120	NO
Inorganics							
aluminum	15,000	3825	4250	2/2	NO	230,000	NO
arsenic	21	5.7	8.05	2/2	NO	0.97	YES
barium	42.5	19.1	20.6	2/2	NO	5,500	NO
calcium	1,400	512	747	2/2	NO	NA	NA
chromium	31	6.01	6.01	1/2	NO	390	NO
copper	8.39	155	306	2/2	YES	2900	NO
iron	15,000	5280	6540	2/2	NO	NA	NA
lead	48.4	16	29	2/2	NO	500	NO
magnesium	5,600	939	1010	2/2	NO	NA	NA
manganese	300	54.3	67.9	2/2	NO	7,800	NO
mercury	0.22	0.105	0.105	1/2	NO	23	NO
nickel	14	4.8	5.82	2/2	NO	1,600	NO
potassium	1,700	541.5	588	2/2	NO	NA	NA
sodium	131	193	213	2/2	YES	NA	NA
vanadium	28.7	5.3	5.38	2/2	NO	550	NO
zinc	35.5	4156.8	8300	2/2	YES	23,000	NO
Other							
total petroleum hydrocarbons	NA	73.5	159	2/2	NA	NA	NA

Notes:
[a] Base-wide background soil inorganics database
[b] Surface soil samples from sampling stations 28E-92-01X and 28E-92-02X
NA = not available
ug/g = micrograms per gram

Table 5-2
Human Health PRE Evaluation of Subsurface Soil
Study Area 28 – Waste Explosive Detonation Range (Training Area 14)

Decision Document
Fort Devens

Analyte	Soil Background Concentration [a] (ug/g)	Detected Concentration [b] Average (ug/g)	Detected Concentration [b] Maximum (ug/g)	Frequency of Detection	Maximum Exceeds Background ?	Region III Commercial/Industrial Concentration (ug/g)	Maximum Exceeds Region III Concentration ?
Organics							
4,4'-DDT		1.6	1.6	1/2		8.4	NO
4,4'-DDD		0.045	0.045	1/2		12	NO
4,4'-DDE		0.38	0.38	1/2		8.4	NO
n-nitrosodiphenylamine		1.5	1.5	1/2		580	NO
Inorganics							
aluminum	15,000	4945	5340	2/2	NO	3,000,000	NO
antimony	NA	3.23	3.23	1/2	NA	410	NO
arsenic	21	9.4	10.8	2/2	NO	1.6	YES
barium	42.5	26.3	27	2/2	NO	72,000	NO
beryllium	0.347	0.74	0.74	1/2	YES	0.67	YES
calcium	1,400	451	642	2/2	NO	NA	NA
chromium	31	7.65	7.65	1/2	NO	5,100	NO
cobalt	NA	2.51	2.51	1/2	NA	NA	NA
copper	8.39	116.5	228	2/2	YES	38,000	NO
iron	15,000	11320	18300	2/2	YES	NA	NA
lead [c]	48.5	92.6	180	2/2	YES	500	NO
magnesium	5,600	946	972	2/2	NO	NA	NA
manganese	300	121.7	199	2/2	NO	100,000	NO
nickel	14	6.2	8.17	2/2	NO	20,000	NO
potassium	1,700	543	693	2/2	NO	NA	NA
selenium	NA	0.584	0.584	1/2	NA	5,100	NO
sodium	131	205.5	229	2/2	YES	NA	NA
vanadium	28.7	6.5	6.7	2/2	NO	7,200	NO
zinc	35.5	4158.2	8300	2/2	YES	310,000	NO
Other							
total petroleum hydrocarbons	NA	46.2	48.4	2/2	NA	NA	NA

Notes:
[a] Base-wide background soil inorganics database
[b] Surface soil samples from sampling stations 28E-92-01X and 28E-92-02X
[c] The Region III Residential Soil concentration for Lead was used as a surrogate for the commercial/industrial concentration for lead.
NA = not available
ug/g = micrograms per gram

Table 5-3
Human Health PRE Evaluation of Groundwater
Study Area 28 – Waste Explosive Detonation Range (Training Area 14)

Decision Document
Fort Devens

Analyte	Groundwater Background Concentration (ug/L)	Detected Concentration [a]		Frequency of Detection	Maximum Exceeds Background?	Drinking Water Standard/Guideline [b] (ug/L)	Maximum Exceeds Standard/Guideline?
		Average (ug/L)	Maximum (ug/L)				
Organics							
bis(2-ethylhexyl)phthalate		8.5	8.6	2/9		6.1	YES
chloroform		0.55	0.55	1/9		5	NO
Inorganics							
aluminum	6870	4426.7	11100	9/9	YES	50-200	YES
arsenic	10.5	7.4	15.9	6/9	YES	50	NO
barium	39.6	32.4	73.6	9/9	YES	2000	NO
calcium	14700	3887.8	7530	9/9	NO	NA	NA
chromium	14.7	10.9	14.1	3/9	NO	100	NO
copper	8.09	8.9	8.85	1/9	YES	1300	NO
iron	9100	4850	12300	9/9	YES	300	YES
lead	4.25	2.6	4.77	9/9	YES	15	NO
magnesium	3480	1264.2	3010	9/9	NO	NA	NA
manganese	291	122.5	252	9/9	NO	50	YES
potassium	2370	1825.9	3640	9/9	YES	NA	NA
silver	4.60	4.92	4.92	1/9	YES	50	NO
sodium	10800	3570	8600	9/9	NO	28000	NO
vanadium	11	14.1	14.6	2/9	YES	260	NO
zinc	21.1	38.3	51.8	8/9	YES	5000	NO
Anions/Cations							
nitrite/nitrate	NA	322.6	1900	9/9	NA	10000	NO
Other							
total suspended solids	NA	85200	108000	5/5	NA	NA	NA

Notes:
[a] Based on unfiltered samples from Round 1 and Round 2
[b] Includes the lowest of either the EPA or MA drinking water standards, or if no federal standard or guideline is available, the Region III tap water concentration
SA 28 is represented by the following monitoring wells: 28M-92-01X through 28M-92-04X (including one duplicate sample).
NA = Not available
ug/L = micrograms per liter

Table 6-1
Ecological PRE Evaluation of Surface Soil
Study Area 28 – Waste Explosives Detonation Range (Training Area 14)

Decision Document
Fort Devens

Analyte	Soil Background Concentration [a] (ug/g)	Concentration [b] Average (ug/g)	Concentration [b] Maximum (ug/g)	Frequency of Detection	Maximum Exceeds Background?	Ecological Benchmarks (ug/g)	Maximum Exceeds Benchmark?
Organics							
4,4'-DDT	NA	0.051	0.051	1/2	NA	1.07	NO
4,4'-DDE	NA	0.016	0.016	1/2	NA	1.07	NO
bis (2-ethylhexyl) phthalate	NA	1.1	1.1	1/2	NA	84	NO
Inorganics							
aluminum	15000	3825	4250	2/2	NO		
arsenic	21	5.7	8.05	2/2	NO		
barium	42.5	19.1	20.6	2/2	NO		
chromium	31	6.01	6.01	1/2	NO		
copper	8.39	155	306	2/2	YES	34	YES
lead	48.4	16	29	2/2	NO		
manganese	300	54.3	67.9	2/2	NO		
mercury	0.22	0.105	0.105	1/2	NO		
nickel	14.0	4.8	5.82	2/2	NO		
vanadium	28.7	5.3	5.38	2/2	NO		
zinc	35.5	4156.8	8300	2/2	YES	640	YES

Notes:
[a] Base-wide background soil inorganics database
[b] Surface soil samples from sampling stations 28E-92-01X and 28E-92-02X. 28M-92-04X was sampled in this area, but was not analyzed
NA = not available
ug/g = micrograms per gram